

Research Article

DOI : 10.15740/HAS/AJSS/11.1/151-154

Effect of nitrogen management using leaf colour chart (LCC) on growth, yield attributes and yield in transplanted rice (*Oryza sativa* L.)

■ BHUPENDER SINGH AND P. K. SHARMA

Received : 19.03.2016; Revised : 10.04.2016; Accepted : 06.05.2016

MEMBERS OF RESEARCH FORUM:

Corresponding author :
BHUPENDER SINGH, Krishi Vigyan
Kendra, KHEDA (GUJARAT) INDIA

Co-authors :
P. K. SHARMA, Krishi Vigyan Kendra,
KHEDA (GUJARAT) INDIA

Summary

A field experiment on rice (cv. GURJARI) was conducted during 2013-14 to 2015-16. The study was conducted by Krishi Vigyan Kendra, Kheda to compare the farmer's practices of application of N fertilizer with N fertilizer application as per leaf colour chart. The N fertilizer application as leaf colour chart recorded superior in growth and yield attributes as compared to farmer's practices. The grain yield was recorded 47.7 q/ha and net income and B:C ration recorded Rs. 25950 /ha and 1:1.69 on pooled basis in N application as per LCC. The N save over farmer practices was recorded 48.8 per cent.

Key words : Leaf colour chart, Rice, Nitrogen management, Yield, Economics

How to cite this article : Singh, Bhupender and Sharma, P. K. (2016). Effect of nitrogen management using leaf colour chart (LCC) on growth, yield attributes and yield in transplanted rice (*Oryza sativa* L.). *Asian J. Soil Sci.*, 11 (1) : 151-154 : DOI : 10.15740/HAS/AJSS/11.1/151-154.

Introduction

Rice (*Oryza sativa* L.) is an important staple food crop grown worldwide. It is the most important food crop of the world, next to wheat for human consumption. In Gujarat state rice occupies about 7.00 to 8.00 per cent of gross cropped area of the state and account 14 per cent of the total food grain production. It is grown about 6.5 to 7.5 lakh hectares of land comprising nearly 55-60 per cent of low land and 40-45 per cent of upland rice (Anonymous, 2011). Most of the area under rice crop is confined to middle and south Gujarat comprising the districts of Kheda, Anand, Vadodara, Dahod, Godhra, Ahmadabad, Surat, Valsad, Dang and Navsari. Rice is one of the important commercial crops of Kheda district having with total area of 0.7 m ha with total production of 1.5 million tones and productivity 2143 kg per ha during

2012-13. The productivity is very low in comparison to nation productivity.

Among various reasons for this low productivity, inefficient utilization of nitrogen is considered to be the most critical one. Nitrogen (N) is the nutrient that most often limits crop production (Shukla *et al.*, 2004). Cereals including rice accounted for approximately 50 per cent of the worldwide N fertilizer utilized (IFA, 2009). Due to the fact that farmers in many parts of the word tend to apply N fertilizer in an inefficient excess of the requirements (Singh *et al.*, 2002), N recovery efficiency (REN) in rice plant is low. The timing of N fertilizer applications synchronizing with plant needs is crucial for realizing higher yield in transplanted rice. However, correct diagnosis of N status of leaves is necessary to determine the need for top dressing. Leaf colour is

generally used as visual indicator of rice crop need for N fertilizer as the colour intensity is directly related to leaf chlorophyll content and N status of leaf. Leaf colour chart is a simple and inexpensive tool that can help farmer to determine the right time of N application to rice by measuring leaf colour intensity (Balasubramanian *et al.*, 2000; Witt and Dobennann, 2002). Keeping in view these considerations, present study was undertaken at farmers field to assess the nitrogen use efficiencies using leaf colour chart in rice. The leaf colour chart developed by DSR, Hyderabad and manufactured by nitrogen parameters was evaluated for scheduling nitrogen application to transplanted rice.

Resource and Research Methods

Study site :

The Kheda district is situated in the middle part of Gujarat. On the basis of physiographical and geographical regional characteristics, it lies in between 22°70' and 23°8' N latitude and 72°15'- 73°78' E longitude. The total geographical area of district is 3, 94,388 ha, out of that 3,04,669 ha area are cultivated. The average rainfall of the district is 883 mm. Maximum and minimum temperatures are 35-42°C and 10-14°C, respectively. The soils of the Kheda district are under the broad group of alluvial soils. The major crops like rice, cotton etc. are grown in *Kharif*. During *Rabi* (winter) crops are tobacco, wheat, tomato etc. Main source of irrigation are canal, open well and bore well.

A farmer field trial was conducted during the three consecutive *Kharif* seasons of 2013, 2014 and 2015 in different villages *i.e.* Siholadi, Maliyataj, Ratanpur of Matar tehsil of Kheda district of Gujarat. At each location representative soil sample was collected and analyzed for pH with glass electrode using soil to water ratio of 1:2, electrical conductivity (EC) in same extract was determined with EC meter. Soil organic carbon was

determined using Walkley and Balck method (Walkley and Balck, 1934). Available phosphorus was determined using 0.5 M NaHCO₃ at pH 8.5 and colour for colorimetric measurement was developed with SnCl₂ (Olsen *et al.*, 1954) method. Available potassium were determined using the ammonium acetate method (Hanway and Heidel, 1952).

The rice variety Gurjari was sown during the study. The different treatments were:

- T₁ Farmers practices (200-230: 45 :00 N:P:K, at the time of basal (100% P), after N fertilizer applied in two or three splits on different growth
- T₂ Recommended dose of fertilizers as per leaf colour chart (80:25: 00 N: P: K, basal (40% N and 100% P) and remained dose of N applied as per LCC. (RDF as per soil testing basis).

Leaf colour chart measurement :

Leaf colour chart consisting of six green shades from yellowish green to dark green, showing increasing greenness with increasing number, was used in this study. The chart was used to take 10 days interval reading starting 14 DAT. Ten disease-free rice plants were randomly selected in the plot, and the colour of the youngest fully expanded leaf of the selected plant was compared by placing its middle part on top of the colour strip in the chart. If 6 or more leaves read equal or below the treatments critical value (LCC 4), a dose of 25 kg N ha⁻¹ was applied as treatment in T₂ plot.

Research Findings and Discussion

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Soil fertility status :

The soil of the adopted villages were low in organic

| Parameters | Maliyataj village | | | Siholadi village | | | Ratanpur village | | |
|------------------|-------------------|--------|--------|------------------|--------|--------|------------------|--------|--------|
| | Min. | Max. | Mean | Min. | Max. | Mean | Min. | Max. | Mean |
| pH | 7.26 | 8.01 | 7.76 | 7.83 | 8.36 | 8.07 | 7.78 | 8.20 | 7.95 |
| EC (dS/m) | 0.40 | 0.83 | 0.59 | 0.75 | 1.00 | 0.87 | 0.60 | 1.35 | 0.90 |
| OC (%) | 0.33 | 0.51 | 0.41 | 0.46 | 0.49 | 0.47 | 0.23 | 0.61 | 0.40 |
| Avail. P (kg/ha) | 24.05 | 40.72 | 34.49 | 29.21 | 32.80 | 31.55 | 25.72 | 32.68 | 29.33 |
| Avail. K (kg/ha) | 206.08 | 369.60 | 276.52 | 245.28 | 403.20 | 321.81 | 211.68 | 576.80 | 359.33 |

carbon, low to medium in available phosphorus, high in available potassium. The pH and electrical conductivity of soils of all villages were normal in nature. The organic carbon, available phosphorus, available potassium were recorded in Maliyataj, Siholadi and Ratanpur villages having low, medium and high, respectively. The ranges of soil properties as given in Table 1.

Growth and yield attributes :

The pooled data on various growth parameters (Table 2) indicated that plant height was higher in T_2 on pooled basis due to steady supply of N applied at seedling stage helped to produce favourable effect on growth attributes. Among the treatments, T_2 (use N fertilizer as per LCC) recorded higher tiller per plant on pooled basis and it was 6.49 per cent higher than farmer practices. Panicle length, number of grain per panicle and test weight at harvest was recorded higher in T_2 as compared to T_1 . The grain yield was 2.80 per cent higher in treatment where N fertilizer applied as per leaf colour chart. The results showed that the farmers can achieve the grain yield by N management using leaf colour chart. However, several other experimenter reported higher grain yield of rice at LCC 4 and suggested for adoption of LCC 4 to be optimum value for real time N management considering higher grain yield and N saving (Budhar, 2005; Balaji and Jawahar, 2007 and Sathiya and Ramesh, 2009).

N management in rice :

Application of N as per LCC resulted using total of 90.7 kg N/ha which was equivalent to the recommended N dose whereas, farmer practices total N used 185.8 kg/ha. The N save over farmer practices was recorded 48.8 per cent without loss in grain yield of rice.

Economics analysis :

The data in Table 3 revealed that paddy under treatment recorded 15.6 per cent higher net return (Rs. 25950 /ha) and B:C. ratio (1:1.69) as compared to the local check where farmers got net returns and B:C ratio of Rs. 22447/ ha and 1:1.59 on pooled basis, respectively. Similar finding also reported by Raddy and Pattar (2006) that the leaf colour chart appeared to be an easy and inexpensive tool for efficient N management in irrigated transplanted rice. The leaf colour chart based application of N recorded higher grain yield and net returns besides resulting in greater savings in fertilizer N and can be easily adopted by famers.

Conclusion :

In the view of the results obtained in this study it may be concluded that farmers should use N fertilizer as per leaf colour chart in paddy crop, save the excess cost of N fertilizer and get higher net profit. Farmer determine the right time of N application to rice by measuring leaf colour intensity with leaf colour chart.

Table 2 : Growth, yield attributes and grain yield of rice as influenced by use of N application as per leaf colour chart

| Treatments | Plant height at harvest (cm) | | | | Number of tiller /plant | | | | Panicle length (cm) | | | |
|----------------------------|------------------------------|-------|--------|--------|-------------------------|------|-------|--------|---------------------|------|------|--------|
| | 2013 | 2014 | 2015 | Pooled | 2013 | 2014 | 2015 | Pooled | 2013 | 2014 | 2015 | Pooled |
| Farmer practices (T_1) | 134.17 | 133.4 | 135.12 | 134.23 | 7.67 | 7.63 | 7.71 | 7.67 | 21.1 | 20.9 | 21.6 | 21.2 |
| Use of LCC (T_2) | 137.17 | 137.7 | 135.00 | 136.6 | 8.33 | 8.51 | 7.90 | 8.20 | 22.9 | 22.1 | 23.6 | 22.9 |
| | Number of grain /panicle | | | | Test weight (g) | | | | Grain yield (q/ha.) | | | |
| | 2013 | 2014 | 2015 | Pooled | 2013 | 2014 | 2015 | Pooled | 2013 | 2014 | 2015 | Pooled |
| Farmer practices (T_1) | 151.00 | 167.6 | 161.2 | 159.93 | 25.9 | 24.9 | 25.15 | 25.30 | 42.1 | 45.6 | 51.7 | 46.46 |
| Use of LCC (T_2) | 154.17 | 171.1 | 164.5 | 163.2 | 27.1 | 25.8 | 25.84 | 26.2 | 44.1 | 47.4 | 51.7 | 47.7 |

Table 3 : Effect of N application as per leaf colour chart on economics in rice crop

| Treatments | Net income (Rs.) | | | | B:C ration | | | | N used (kg/ha) | | | | % N save over farmer practices |
|----------------------------|------------------|-------|-------|--------|------------|------|------|--------|----------------|-------|-------|--------|--------------------------------|
| | 2013 | 2014 | 2015 | Pooled | 2013 | 2014 | 2015 | Pooled | 2013 | 2014 | 2015 | Pooled | |
| Farmer practices (T_1) | 21707 | 22338 | 23296 | 22447 | 1.62 | 1.55 | 1.62 | 1.59 | 172.3 | 194.9 | 190.1 | 185.8 | - |
| Use of LCC (T_2) | 24544 | 27302 | 26002 | 25950 | 1.7 | 1.71 | 1.65 | 1.69 | 88.6 | 96.6 | 87 | 90.7 | 48.8 |

Literature Cited

- Anonymous (2011). Package of practices for paddy in Gujarat. Anand Agricultural University, Anand, GUJARAT (INDIA).
- Balaji, T. and Jawahar, D. (2007).** Comparison of LCC and SPAD methods for assessing nitrogen requirement of rice. *Crop Res.*, **33** (1, 2 & 3) : 30-34.
- Balasubramanian V., Morales, A.C., Cruz, R. T., De, N.N., Tan, P.S. and Zaini, Z. (2000).** Leaf colour chart (LCC): A simple decision tool for nitrogen management in low land rice. Poster presented at the Annual American Society of Agronomy Annual meeting, Minneapolis, Minnesota, 5-9.
- Budhar, M.N. (2005).** Leaf colour chart based nitrogen management in direct seeded puddled rice (*Oryza sativa* L.). *Fertil. News*, **50** (3) : 41- 44.
- Hanway, J.J. and Heidel, H. (1952).** Soil analysis methods as used in Iowa state collage soil testing laboratory. *Iowa Agric.* **57** : 1-31.
- Olsen, S.R., Cole, C.V., Watanable, F.S. and Dean, L.A. (1954).** Estimation of available phosphorus in soils by extraction with sodium bicarbonate. Circular 939.US Department Agriculture Washington, DC. USA
- Raddy, B. and Pattar, P.S. (2006).** Leaf colour chart-a simple and inexpensive tool for nitrogen management in transplanted rice (*Oryza sativa*). *Indian J. Agric. Sci.*, **76** (5): 289-292.
- Sathiya, K. and Ramesh, T. (2009).** Effect of split application of nitrogen on growth and yield of aerobic rice. *Asian J. Exp. Sci.*, **23**(1) : 303-306.
- Shukla, A.K., Ladha, J.K., Singh, V.K., Dwivedi, B.S., Balasubramanian, V., Gupta, R.K., Sharma, S.K., Singh, Y., Pathak, H., Pandey, P.S., Padre, A.T. and Yadav, R.L. (2004).** Calibrating the leaf colour chart for nitrogen management in different genotypes of rice and wheat in a systems perspective. *Agron. J.*, **96**: 1606-1621.
- Singh, Bijay, Singh, Yadvinder, Ladha, Jagdish K., Bronson, Kevin F., Vethaiya, Balasubramanian, Singh, Jagdeep and Khind, Charan S. (2002).** Chlorophyll meter and leaf colour chart-based nitrogen management for rice and wheat in northwestern India, *Agron. J.*, **94** (4) : 821-829.
- Subbaiah, S.V. (2006).** *Rice meeting challenges*, The Hindu Survey of Indian Agriculture, pp. 50-54.
- Walkley, A. and Balck, C.A. (1934).** An examination of different methods for determining soil organic matter and proposed modification of the chromic acid titration method. *Soil Sci.*, **37** : 29-38.
- Witt, C. and Dobennann, A. (2002).** A site specific nutrient management approach for irrigated lowland rice in Asia. *Better Crops Internat.*, **16** (1): 20-40.

Webliography

- IFA (2009). Statistics (Online). Assessment of fertilizer use by crop at the global level. Available at www.fertilizer.org, 17 May 2010, PARIS, FRANCE.

★ ★ ★ ★ ★ of ^{11th} Year Excellence ★ ★ ★ ★ ★